Conducting an Endoscopic Sinus Surgery Dissection Course via Telesimulation: An Initial Experience

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Abstract

Objective. Medical education has been severely disrupted by the COVID-19 pandemic, with many in-person educational activities transitioned to distance learning. To overcome this challenge, we utilized telesimulation to conduct an endoscopic sinus surgery (ESS) dissection course. Our objectives were to evaluate the effectiveness and acceptability of telesimulation as an alternative to in-person dissection courses for resident training.

Study Design. Cross-sectional study.

Setting. Academic medical centers.

Methods. The course, consisting of lectures and hands-on dissection, was conducted entirely over the Zoom platform. The participants were allocated outpatient clinic rooms at 2 hospitals, while the instructors supervised remotely. We utilized the camera systems in the clinics and 3-dimensional–printed sinus models for the dissection. Laptops with cameras were used to capture the endoscopic image and the dissector. We evaluated the effectiveness of telesimulation, the surgical skills of the participants, and the course by way of pre- and posttest and a questionnaire.

Results. A total of 8 participants and 7 instructors participated in the study. Telesimulation was found to be effective in helping participants gain knowledge and skills in ESS. All participants improved on their pretest scores (31.5% vs 73.4%, *P* = .003) and felt more comfortable with ESS postcourse (1.9 vs 3.2, *P* = .008). Participants and instructors opined that telesimulation is an acceptable alternative to in-person dissection courses.

Conclusion. Telesimulation is an effective, acceptable, and viable alternative to in-person dissection courses. It also has the advantage of overcoming temporal and geographic constraints to surgical training in residency.

Keywords

telesimulation, endoscopic, sinus surgery, medical education, dissection course

The COVID-19 pandemic has severely disrupted medical education. With the need for social distancing measures, in-person educational activities have now transitioned to distance learning. While lecture-based portions of the curriculum can easily be delivered via videoconferencing, providing technical skills training over distance learning can be challenging. In addition, during the pandemic, a large number of elective operations have been canceled or postponed,[1] further affecting the surgical education of our otolaryngology–head and neck surgery (OTL-HNS) residents.

Traditional in-person dissection courses play an important role, where surgical trainees can learn and practice without the risk or resource utilization of the operation room. However, these courses are costly and may not always be readily available in all localities. Travel restrictions imposed during the pandemic, as well as the increased difficulty in obtaining cadavers, have reduced the availability and accessibility of such courses. For these reasons, there is an impetus to find alternative ways to teach surgical skills and ideally make them more accessible as well.

Telesimulation has been well described for simulation-based teaching of procedural skills, such as laparoscopic surgery, regional anesthesia, and insertion of intraosseous lines.[2-6] Telesimulation is defined as a distance learning

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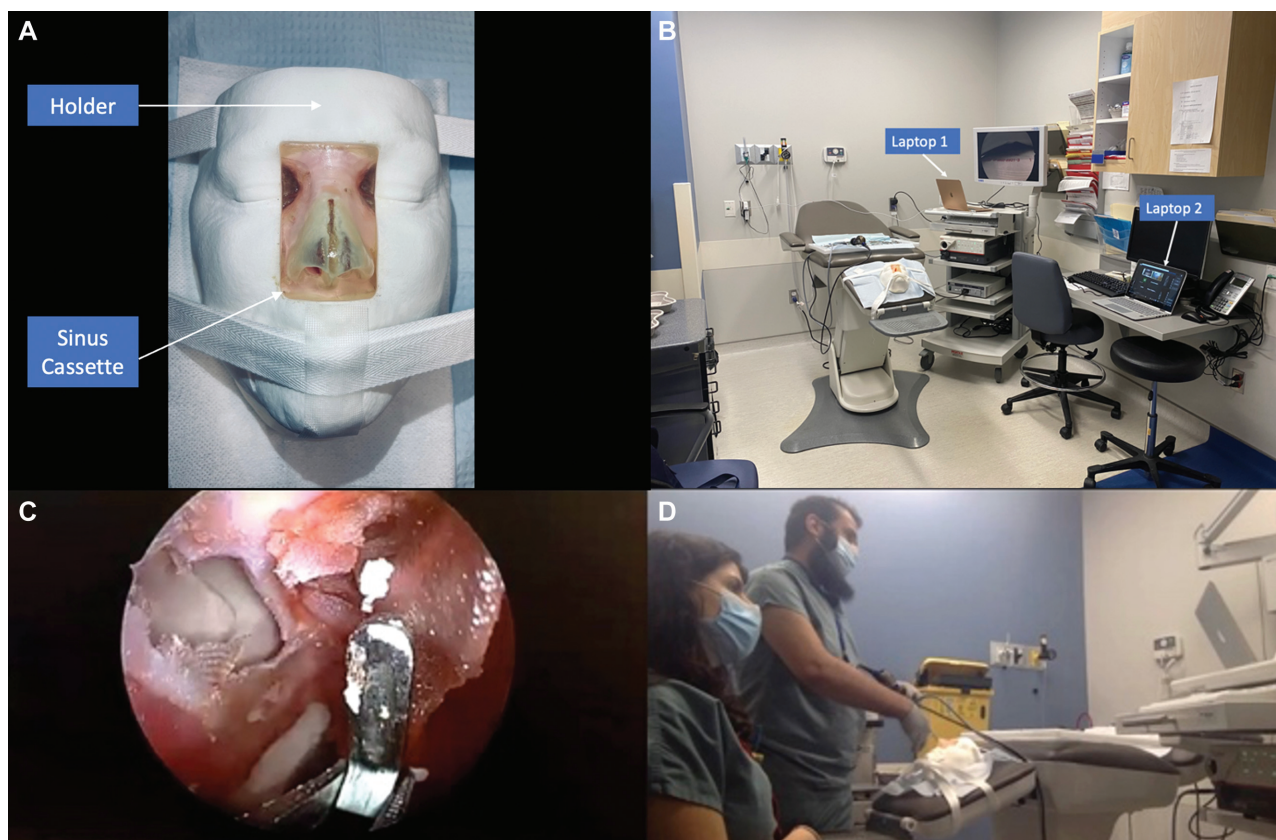[2]Institute of Health Sciences Education, McGill University, Montreal, Canada

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Figure 1. (A) Setup of 3-dimensional–printed sinus model. (B) Setup of telesimulation. (C, D) Views from laptops 1 and 2 show the image from the endoscope and the dissector, respectively.

method in which telecommunication and simulation resources are utilized together to build knowledge and provide skills training.[7] The first reported telesimulation course for endoscopic sinus surgery (ESS) took place on February 2021, led by Professors Peter-John Wormald and Alkis Psaltis.[8] This course was a tie-up between the University of Adelaide Medical School in Australia and Hokkaido University in Japan. The course was conducted remotely by using dedicated telehealth software from Quintree technology and 3-dimensional (3D)–printed sinus models from Fusetec. There were 3 participants, sited in Hokkaido, who had hands-on dissection of the 3D-printed models, and they were supervised by Professors Wormald and Psaltis, who were sited remotely in Adelaide.

Inspired by this novel way of conducting an ESS dissection course, we sought to utilize telesimulation to conduct a dissection course for our residents. However, in contrast to the previously mentioned telesimulation course and to keep costs low, our course utilized readily available materials and software, such as laptops, videoconferencing software, and the equipment in our outpatient OTL-HNS clinics. Therefore, the objectives of this study were to evaluate the effectiveness and acceptability of telesimulation as a viable alternative to a conventional in-person ESS dissection course.

Methods

Utilizing the framework for curriculum development by Kern et al[9] as a guiding principle, we developed and evaluated the effectiveness and acceptability of telesimulation by conducting it as part of the in-house residents' ESS dissection course at McGill University Health Centre. Ethics approval was obtained from the McGill Institutional Review Board (A04-E20-15B). Details of the setup and procedure are described in turn.

Telesimulation Setup

The course was held in the outpatient clinics at 2 hospitals, the Royal Victoria Hospital and Jewish General Hospital in Montreal, Canada. Utilizing the camera systems available in the outpatient clinics as well as the dissection instruments provided by Karl Storz, we conducted the course entirely over the Zoom platform (Zoom Video Communications Inc). For simulation, high-fidelity 3D-printed sinus models (Fusetec) were utilized. The 3D-printed sinus model consisted of a holder and interchangeable anatomic sinus cassettes, modeled after real patients with various anatomic sinus configurations (**Figure 1A**).

All McGill OTL-HNS residents were invited to participate in the course. The participants were paired up, and each pair was assigned an outpatient clinic room in one of the hospitals. All rhinologists working as attendings within the McGill University Health Centre were invited to help with the course as instructors. The instructors were in a separate outpatient clinic room or office or the comfort of their own homes. Each outpatient clinic room was equipped with its own camera

tower, dissection instruments, 3D-printed sinus model, and 2 laptops (**Figure 1B**). The cameras of laptops 1 and 2 were used to capture the endoscopic image and the dissector (**Figure 1C**, **D**), respectively. Each instructor had a view of the camera feed in the assigned virtual breakout room. Instructors who were situated in the outpatient clinic rooms would also be on stand-by to address any possible technical issues.

The full day course consisted of lectures, dissection demonstrations, and hands-on dissection of the 3D-printed sinus models. A total of 5 lectures were given by 5 instructors, who were sited at home or at 1 of the 2 designated hospitals. For the lectures and dissection demonstration, all participants and instructors attended via the main virtual room. For the hands-on dissection session, participants and instructors were assigned virtual breakout rooms, each consisting of 1 or 2 instructors per pair of participants. The instructors were rotated to different breakout rooms for each section of the hands-on dissection. This allowed participants to interact with as many instructors as possible by the end of the course. All participants were given preoperative imaging of the sinus cassette model so that they could analyze its anatomy before the dissection.

Participant Assessment and Course Evaluation

Prior to and after attending the course, participants completed a pre- and posttest, both consisting of the same set of 10 open-ended questions (Supplement 1, available online). These questions served to assess the participants' knowledge on sinus surgery. Participants also rated their pre- and postcourse comfort levels in performing the various steps of ESS, using a 5-point Likert scale ranging from ''requiring complete hands-on guidance'' to ''complete independence.''

For course evaluation, participants and instructors completed a questionnaire that explored their perceived educational value of the course, their telesimulation experience, and their opinion on telesimulation as a feasible and viable alternative to in-person dissection courses (Supplement 2, available online). We evaluated the course for the technological and educational aspects. The questionnaire consisted of a 5-point Likert scale ranging from 0 (strongly disagree) to 5 (strongly agree), as well as open-ended questions. Questions were identical for participants and instructors, except for the addition of question 4.1 for participants. Additional feedback on the course was obtained via open-ended questions where the participants and instructors were asked to list the strengths and weaknesses of the course, as well as any comments that they might have.

Statistical Analysis

For the pre- and posttest evaluating the participants' knowledge, we calculated the percentage score of each participant and utilized the paired-samples *t* test to compare the pre- and posttest scores. For the pre- and postcourse questionnaire evaluating the participants' skills, the self-reported scores were analyzed via a Wilcoxon signed rank test for matched samples and a Mann-Whitney *U* test for unmatched samples.
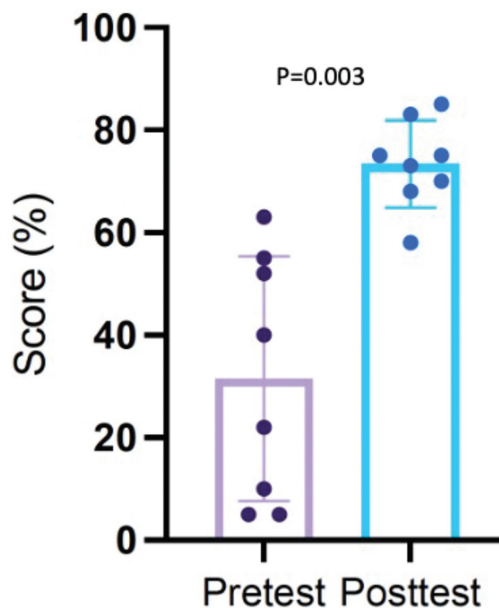
Figure 2. Pre- and posttest knowledge scores. Mean (SD).

For the questionnaire evaluating the course, negatively worded items were reversed prior to presentation. Statistical analyses were performed with Prism version 9.0 (GraphPad). The significance level was set at $P < .05$. For the free-text comments, we categorized the comments into common themes.

Results

The study consisted of 8 participants and 7 instructors. Half the participants were male, and half had previously attended at least 1 ESS dissection course. Participants were in their second (n = 2), third (n = 3), and fourth (n = 3) years of residency training. Three instructors were actively involved in organizing the course, and they were excluded from the study to avoid biases.

Knowledge Score

All participants improved on their scores postcourse, and the knowledge gain was statistically significant ($P = .003$). The largest improvement seen in a participant was 75% while the smallest was 6%. The mean pre- and posttest scores were 31.5% (SD, 23.9%) and 73.4% (SD, 8.5%), respectively (**Figure 2**).

Self-reported Comfort Level for ESS Skill

All participants reported feeling more comfortable with ESS after the course, and this held true across all the sinuses. Participants felt most comfortable dissecting the maxillary sinus and the least comfortable with the frontal sinus (**Figure 3**). Postcourse, the participants had the largest increase in comfort level in dissecting the sphenoid sinus (difference, 1.5), while there was an increase of only 1.2 for the other 3 sinuses.

As compared with year 2 or 3 residents, year 4 residents had a higher comfort level precourse (mean ± SD; 2.3 ± 0.27
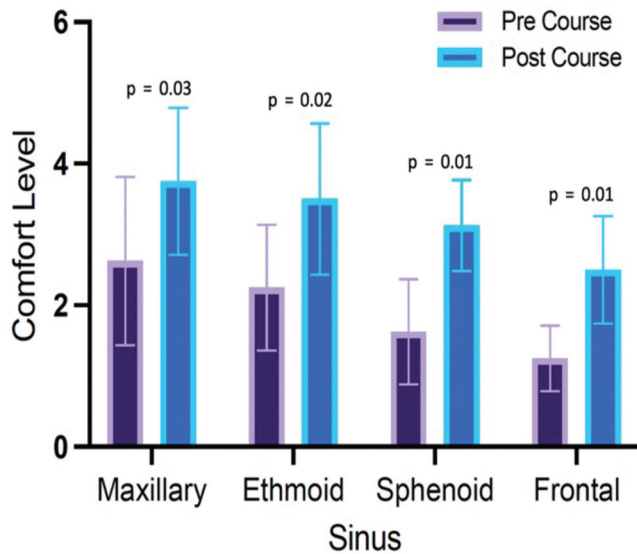
Figure 3. Pre- and postcourse self-perceived comfort level for ESS skill. Mean (SD). ESS, endoscopic sinus surgery.
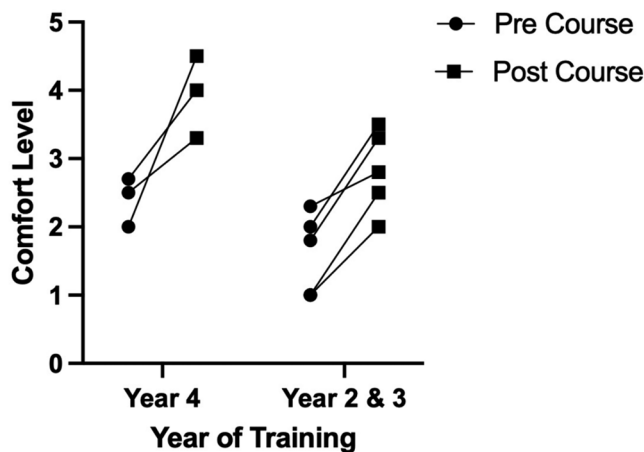
Figure 4. Self-perceived comfort level by year of residency.

vs 1.58 ± 0.59, *P* = .11) and postcourse (3.93 ± 0.60 vs 2.82 ± 0.61, *P* = .11; **Figure 4**). Similarly, those with prior experience attending a dissection course scored a higher mean comfort level precourse (2.05 ± 0.76 vs 1.78 ± 0.56, *P* = .46) and postcourse (3.58 ± 0.87 vs 2.9 ± 0.67, *P* = .40) as compared to those without prior experience.

Course Evaluation

Overall the participants and faculty members rated the course favorably and agreed that telesimulation was a feasible and viable alternative to an in-person dissection course. For the technological aspects, the score from participants and instructors was at least 4.5 in all but 1 of the questionnaire items. They agreed that telesimulation allowed them to view, hear, and interact with each other adequately. The lowest rated item was on being distracted by technology, with a mean score of 4.08 by the participants.

For the educational aspects, the participants and instructors agreed that telesimulation was an effective educational tool and the residents had benefited from the course, with a mean score of at least 4.33 across all items. In particular, they agreed that telesimulation was a reasonable substitute to the traditional in-person dissection course (4.5 ± 0.67).

For the free-text comments, feedback was grouped into common themes and then divided into strengths and weaknesses of telesimulation. For strengths, themes included increased interaction with faculty members, increased reach and size of audience, and being a viable option to in-person dissection courses. For weaknesses, themes included the course's quality being dependent on the quality of the audio and video input, as well as the inability of telesimulation to replace in-person dissection courses.

Discussion

With the disruption that the pandemic has brought to medical education over the past year, we sought to develop, implement, and evaluate a sinus dissection course using telesimulation for residents as an alternative to an in-person dissection course. Our results demonstrated that telesimulation is an effective way to gain knowledge and skills in relation to sinus surgery. Having more surgical experience and having attended previous in-person dissection courses make one more comfortable with ESS. Our results showed that a dissection course conducted via telesimulation can effectively equip one with the necessary knowledge and skills and increase one's comfort level with ESS. Our participants and instructors opined that telesimulation is an acceptable and viable alternative to traditional in-person sinus dissection courses.

Interestingly, participants who had previously attended in-person ESS dissection courses reported an increased interaction with instructors for this course conducted via telesimulation. This could be attributed to the assignment and rotation of instructors to designated virtual breakout rooms. This provided participants the opportunity to interact with as many instructors as possible by the end of the course. Franklin and Warren[10] also found that distance learning enabled increased student-teacher interaction. In particular, they noted that introverted participants were more likely to participate freely when the learning environment was less intimidating and conducive for asking questions.

Use of Telesimulation for OTL-HNS Residency Training

Telesimulation has multiple strengths and the potential to be utilized more widely in residency training, and it is applicable beyond the setting of the COVID-19 pandemic. First, it can circumvent temporal and geographic obstacles to training. Without the need to travel, it provides greater convenience and more access to dissection courses for health care workers from resource-limited countries, who would otherwise not have the opportunity to attend an in-person dissection course. Okrainec et al[4] found that telesimulation was an effective method for teaching the fundamentals of laparoscopic surgery

to surgeons in Botswana, Africa, which they conducted remotely from Toronto, Canada.

Second, for institutions that are already fully equipped and are performing sinus surgery on a regular basis, conducting a telesimulation-based dissection course with 3D sinus models can be convenient, as there is no need to obtain additional equipment and there is no biohazard risk. This allows institutions to use their surgical instruments for the dissection as well.

Third, telesimulation can be harnessed to facilitate interinstitutional networking and collaboration. With more institutions adopting this modality for residency training, there can be more rapid dissemination of content in medical education.[11,12]

Challenges

While the strengths of telesimulation are manifold, there are challenges associated with telesimulation. First, the quality of the audio and visual input is highly dependent on the quality of the internet connection as well as the optics of the camera. In addition, while telesimulation has the potential to circumvent temporal and geographic obstacles to training health care workers in resource-limited countries, the access to broadband in such countries may prove challenging. The World Bank estimates that only 35% of the population in developing countries has access to the internet, as compared with 80% in developed countries.[13]

Second, while laptops are readily available in developed countries, access to computers may be an issue in developing countries. In 2019, just 36.1% of households in developing countries were estimated to have a computer at home.[14]

Last, despite the positive response to telesimulation in our course, we noted that telesimulation cannot completely replace in-person dissection courses. Such courses allow for tactile feedback and demonstration of personal dissection techniques, which cannot be easily replicated via telesimulation.

Despite the challenges, we find that conducting a sinus dissection course via telesimulation and 3D-printed models is a novel education strategy. We found it to be an effective, acceptable, and viable alternative to in-person dissection courses. We believe that this novel education strategy can be more effectively evaluated and improved on.

Limitations

We acknowledge several limitations in our study. First, our sample size was small. With the restrictions in place during the pandemic, holding an in-person sinus dissection course was not possible, and we conducted this course via telesimulation. As it was our first time doing so, we intentionally kept it small to trial this modality. Second, as all participants and instructors were from the same institution, there could have been bias in the course evaluation process due to the halo effect. Third, as lectures and dissection were part of the course, we were not able to determine if the knowledge gained was due to one, the other, or both. The evaluation of this education model was done only at Kirkpatrick's level 1.[15] In addition, the questions in our pretest, posttest, and questionnaire were nonvalidated. Last, we did not collect data from previous in-person dissection courses, which would

have allowed us to directly compare the in-person and telesimulation modalities. We worked around this by administering the pre- and posttest and getting the participants to compare their telesimulation experience with their in-person dissection course.

Future Direction

Further to this pilot study, we would like to evaluate if this model of conducting dissection courses via telesimulation is generalizable on a larger scale, with participation from multiple institutions. We would also like to explore whether there is retention of knowledge and skills by administering a validated assessment tool 3 months postcourse.

Conclusion

Our study showed that telesimulation is an effective, acceptable, and viable alternative to in-person sinus dissection courses. When compared with traditional in-person dissection courses, it has the advantage of overcoming temporal and geographic constraints to surgical training in residency.

Author Contributions

Alex C. Tham, design, conduct, analysis of results, writing of manuscript; **Lamiae Himdi**, conduct of study and writing of manuscript; **Lily H.P. Nguyen**, conduct of study, analysis of results, writing of manuscript; **Saul Frenkiel**, conduct of study and writing of manuscript; **Marc Antoine Tewfik**, design, conduct, analysis of results, writing of manuscript.

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